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A MONTHLY RECORD OF OPHTHALMIC SCIENCE

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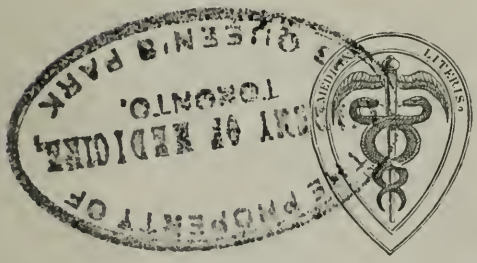

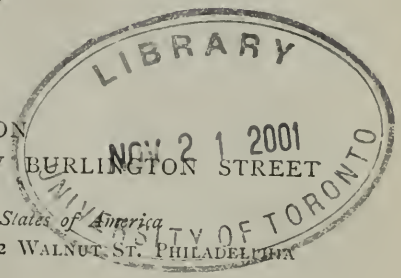

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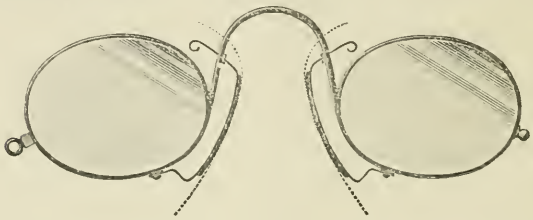

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ASTIGMATISM FOLLOWING CATARACT EXTRACTION AND OTHER SECTIONS OF THE CORNEA.[1]

By Edward Jackson, A.M., M.D.

Professor of Diseases of the Eye in the Philadelphia Polyclinic; Surgeon to Wills Eye Hospital.

In his work on the "Anomalies of Accommodation and Refraction of the Eye," Donders stated: "To the very ordinary causes of altered and consequently irregular arching of the cornea belongs the extraction of cataract. Especially when *prolapsus iridis*, or threatening *prolapsus* has existed, whereby the pupil has lost its central position, or where, with forward projection of the flap, the wound surfaces do not perfectly correspond, we seldom obtain a completely normal arching of the cornea. If the deviation is slight, the power of vision may still be quite sufficient; but on accurate investigation it now appears that the acuteness is defective, and the astigmatism is in this instance also partly capable of correction by giving an oblique position to the convex glass, or by combination with a cylindrical one."

Since the publication of Donders' work, almost every textbook upon the refraction or diseases of the eye has contained an allusion to the subject, but these allusions usually do little more than call attention to the existence

[1] Read before the Section of Ophthalmology at the Pan-American Medical Congress, September, 1893.

of such astigmatism. A few papers upon the subject have appeared from time to time, but so far as I know, only one in the English language, namely, that by Dr. Swan M. Burnett, in the *American Journal of Ophthalmology* for 1889. In view of this, it seems worth while to put on record some observations as to the clinical history of such astigmatism.

Frequency.—It appears to occur almost universally after cataract extraction. In a few of my earlier cases, my notes do not show that it was detected, but in none of these cases was full vision or nearly full vision obtained, and they were not subjected to careful study with the ophthalmometer or the shadow-test, so that their negative evidence is not conclusive.

In forty-eight cases that have been carefully studied, the amounts of astigmatism present were :—

Less than 1D.	...	in 5 cases.
1 to 1.75D.	...	in 6 cases.
2 to 2.75D.	...	in 18 cases.
3 to 3.75D.	...	in 10 cases.
4 to 4.75D.	...	in 4 cases.
5D....	...	in 2 cases.
6, 7, and 8D....	each	in 1 case.

From these statistics, I am inclined to think that those who have found it frequently absent, have failed to note it, as I may have done in the cases previously mentioned, because it was not looked for carefully enough. It would appear from these figures not only that it is present in an amount that can be detected, but also that in a great majority of cases it is present to such a degree that its correction is a matter of considerable importance.

Direction of the Principal Meridians.—All writers who have alluded to this subject have noted what is shown in my own cases, that, contrary to the rule, the principal meridian of greatest hyperopia was at or near the vertical, the section being made either upward or down-

ward. This has been so generally observed that we may take it as settled that the meridian of greatest hyperopia is usually or always perpendicular to the centre of the corneal incision.

In many of my own cases, the slight difference in height between the puncture and counter-puncture clearly influenced the inclination of the principal meridians. The greatest departure from the usual position of the principal meridians was found in cases of astigmatism of low degree. In one case of 0.50D., the most hyperopic meridian was found 55° from the vertical. As to the explanations of the direction of the astigmatism, as well as of its occurrence, more will be said later.

Seat of Astigmatism.—After cataract extraction, this can only be in the surface of the cornea, and in cases of iridectomy also, the ophthalmometer has invariably revealed that the asymmetry had a similar situation.

Time of Appearance and Clinical History.—The first application of accurate methods for the measurement of refraction, subsequent to the operation, has invariably detected the astigmatism present, and in the highest degree exhibited at any time in that particular case. Inspection of the cornea, with or without the use of the Placido disc, from the date of operation, shows that after the effects of cocaine have passed away, and the humours have replaced the extracted lens, the form of the cornea remains normal, although subject to changes by changing pressure from the lids, until the anterior chamber is re-established. Then in the course of two or three days—or sometimes in a few hours—the corneal asymmetry becomes evident, and quickly reaches its maximum. From this time onwards the tendency is for the astigmatism to diminish, until at length a permanent condition is reached. This diminution, however, is not always regular or constant, as was well illustrated in many of the cases. For example:—

Mrs. J. M., aged 54; iridectomy for subacute glaucoma, corneal section upward, well back in sclero-corneal junction, involving one-fifth of its circumference. The eye was operated on on May 14, 1883. It had previously been carefully examined, and found hyperopic 2D., and free from astigmatism. The astigmatism was evident shortly after the operation. In five weeks it had markedly diminished, and + 4 cyl., axis 25°, gave vision equal to 4/5.

At nine weeks there had been no farther change in the refraction, and the above cylinder was ordered for distance, with + 3 sph. added for reading. Sixteen days later she wrote to me complaining that the glasses had begun to hurt her eyes, and she was instructed to discontinue their use.

At fourteen weeks, the refraction was again carefully tested, and found to require for its correction + 2 sph. ⌒ + 2.50 cyl., axis 20°, giving the same vision. At eighteen weeks, the same correction was required, but fearing farther diminution of the astigmatism, she was ordered for distance + 2.25 sph. ⌒ + 2 cyl., axis 20°. Four years later she required + 2.75 sph. ⌒ + 2.50 cyl. axis 13°, and with it obtained vision of 4/4 partly. There was no farther change in the refraction when last seen, more than eight years after the operation.

In watching cases from week to week with the ophthalmometer, it has repeatedly happened that for some weeks the change in the astigmatism was but slight; and then there would suddenly appear a rapid change to what proved to be the permanent condition. On the other hand, there may be, in some cases, a steady diminution of the astigmatism from the time it is first measurable until the permanent condition is reached. Thus:—

R. C., aged 63, after simple extraction, upward section in the margin of the cornea, had:—

At 14 days, astigmatism 15D. convex cyl. axis 155°.

At 21 days, 13.5 cyl.

At 40 days, 11 cyl.

At 54 days, 7.5 cyl. axis now 157°.

At 61 days, 7.5 cyl.
At 75 days, 5.75 cyl.
At 78 days, 5 cyl. axis now 158°.
At 90 days, 4 cyl. axis 158°, giving vision 4/5ths mostly.

In nearly half of my cases capsulotomy was performed while the patient was under observation. No effect from it upon the astigmatism present could be noticed.

Final Amount.—The amount of astigmatism remaining when its condition had become permanent is indicated in the table given in connection with its frequency. It should, however, be noted that all cases in which the astigmatism is given as over 4D. were cases that have not been seen more than five months after the date of operation; and of the cases showing 4D., but two were seen more than six months after the operation. So that it is uncertain whether in any case more than this amount of astigmatism has remained permanently. The one in which the astigmatism was 8D. was last seen only one month after operation. It is certain that in the large majority of cases, the amount of astigmatism diminishes to less than 3D. before it becomes fixed. And in a given case, were it necessary to adjust glasses within the period of probable change of astigmatism, it would be safer to prescribe for this average amount, than for the amount present at the time, if it exceeded this, even though it might have been constant for days or weeks.

When it ceases to Change.—The period during which the astigmatism continues to diminish varies widely. In two eyes, it decreased from 4D. to 2.25D. after a period of six months had elapsed. In another case it had fallen to 2.25D. by the twenty-second day, and no farther change occurred, although the eye was seen for more than a year afterwards. In still another case, it diminished to 1.25D. by the twenty-fifth day, and did not show the slightest change five years later. In still another it fell to 1D. by the twenty-third day.

In about 60 per cent. of the cases the change continued between two and three months, with perhaps a very slight diminution after this. In 15 per cent. permanence was reached in the second month; and in 20 per cent. change continued after the third month. Where the amount remains high at the end of this period, even though it has been for a considerable time stationary, there is strong probability that it will farther diminish later.

All of the cases long under observation—two of them for ten years—seem to show that after a certain period, limited apparently to the first year, or possibly a little longer, the amount of astigmatism becomes quite fixed, and is as little liable to change as in cases of moderate astigmatism not due to operation.

Influence of Complications.—The occurrence of prolapse of the iris or of incarceration, or even of close adhesion of the iris to the corneal stump, notably influences for a time the amount, and delays the diminution of astigmatism, but these conditions appear to produce but little effect upon the final amount and permanence. The influence of prolapse in this direction, unless it be so extensive as to cause great displacement of the corneal flap, is not greater than the influence of incarceration, or of adhesion of the iris to the cornea. In either case the influence appears to be proportioned to the extent to which the corneal wound is involved. Thus, a large incarceration is worse than a small prolapse.

In the series of cases upon which this paper is based, there occurred two of extensive prolapse of the iris allowed to shrink without excision or other operative interference.

W. J., aged 70, by a sudden movement of the eye during the corneal section, caused a doubling of the incision that left about one-third of the margin of the flap hanging as a shaving of corneal tissue, almost completely severed from

its connections. This underwent partial absorption, delaying healing of the wound; and the restlessness, which had caused the original accident, secured an extensive prolapse of the iris. On the twenty-sixth day, he still had 10D. of astigmatism, which, however, had diminished to 3.50D. by the seventy-seventh day, and after that underwent no change.

J. W., aged 42, had a bit of steel lodged in the lens four months previously. The lens was much swollen, and in order to make sure of the removal of the foreign body, a long incision well back in the sclero-corneal margin was employed. Prolapse of the iris occurred and extended until it occupied the whole length of the wound. It reached its maximum in a few days, and then remained without notable change in bulk for thirty days; after which it flattened rapidly, and by the forty-fifth day had gone down entirely to the level of the cornea. On the fifty-first day the astigmatism was 20D.[1] On the fifty-eighth day 11D. At sixty-five days, 9D., and only after five months did it diminish to 5D.

In contrast to this is the course of high astigmatism following simple extraction with normal healing.

Mrs. J. G. B., aged 64. On the twenty-fifth day the astigmatism was 26D. On the twenty-eighth day it had fallen to 23D., and by the seventy-fifth day it was 0.75D.

Nature of the change in the Cornea.—The readings of the ophthalmometer show, first, that the corneal curvature is actually diminished in the meridian of least refraction, usually vertical or nearly so, and that this meridian is flattest at the first examination, and becomes more convex as the astigmatism diminishes. Second,

[1] The dioptres in this and the following case are what were indicated by the Javal ophthalmometer, and considerably higher than the cylinder chosen. Thus when the ophthalmometer showed 11D., the 10D. cylinder was preferred; when it showed 23D. the 18D. cylinder gave the best vision. This is partly because of the distance of the glass in front of the eye, and partly because the constants taken as the basis of the graduation of the Javal instrument do not hold for the eye rendered aphakic by cataract extraction. See paper by Dr. Carl Wieland, *Archives of Ophthalmology*, vol. xxii., p. 37.

that the meridian of greatest curvature, usually horizontal, or approximately so, presents an actual increase over the previous curvature of the cornea; which increase is greatest at the first examination, and diminishes with the astigmatism, sometimes, but not always, passing away altogether by the time the condition of permanency is reached.

To explain these corneal changes, the pressure of the lids, the displacement of the flap, and the action of the extra-ocular muscles upon the globe, have all been invoked. But the astigmatism occurs, typical in form and course, when the flap and stump unite in perfect coaptation, and the pressure of the lids, and action of the extra-ocular muscles have not been shown to differ essentially from their pressure and action on the normal globe.

It seems to me that the explanation of the phenomena of post-operative astigmatism is to be found in the essential fact of an incision through the resisting coat of the eye, temporarily entirely destroying its resistance along a certain line; and that the necessary effects of such an incision, irrespective of any outside influences, are just such as we have observed in the cases in question.

With the incision the resistance of the sclero-corneal coat to the intra-ocular tension along the line of incision drops to zero, and remains there until the flap and stump adhere. During the time that the wound remains open, the intra-ocular tension—at least in the anterior chamber—also remains at zero, and no displacement results. When, however, the wound is closed, the intra-ocular tension is immediately renewed, and the adhesions uniting the flap and stump become a portion of the sclero-corneal coat, which has to resist this tension.

Throughout most of this coat the power of resistance is normal, but the adhesions possess comparatively little power of resistance, and the changes in the neighbouring margins of the flap and stump incident to the pro-

cess of repair materially diminish resistance. It follows, therefore, that we have along the line of incision less resistance to the intra-ocular pressure than at any other portion of the sclero-corneal sac. Necessarily the parts where the resistance is less, protrude. This protrusion causes great increase of curvature in the direction perpendicular to the incision at the line of incision, and this increase of curvature must necessarily be made up by an equal amount of flattening of the neighbouring portions of the cornea and sclera. In the sclera, this flattening being of no particular importance, remains unnoticed. In the cornea it causes the observed flattening of the vertical meridian. So much for the flattening in the meridian perpendicular to the incision.

It has been noticed that the change of outline that occurs is dependent on the bulging at the point of least resistance. The maximum of this bulging will be at the centre of the corneal incision, that is, the centre of the corneal incision is more pushed out from what would be its normal relation to the centre of the globe than any other point of the sclero-corneal coat; and the whole area of the central part of the flap shares more or less in this bulging. We have, therefore, the centre of the upper part of the flap bulging forward. If other parts of the circumference of the cornea remain fixed, as the whole cornea does outside the region of incision, and as the angles of the incision do, to a less extent, because of the support they receive from neighbouring firm tissue, this bulging at the upper margin of the cornea causes the cornea to assume more or less the form of a vertical ridge, comparatively flat in the direction of its length, but with increased curvature from side to side. And, in this increase of curve to get over the ridge, as it were, from side to side, we have the cause of increased curvature in the meridian of greatest curvature.

This explanation is put forward, not as a hypothesis, but as an application of well understood physical laws

to the special case of intra-ocular tension resisted by the sclero-corneal coat which is weakened along a certain line of incision; and it seems to me entirely adequate to the requirements of the phenomena in question, rendering unnecessary any appeal to other special causes to explain post-operative astigmatism.

As the resistance along the line of incision increases with the return of the tissues to the normal, the tendency of intra-ocular pressure is to reproduce the normal spherical curves, or the spherical curves of the normal eye. That it should fail to do this completely is not to be wondered at when one considers the existence of the permanent scar, and the comparative rigidity on account of the age of the patient, of the tissues in which this process generally occurs.

The influence of such complications as prolapse, or incarceration of the iris, is clearly traceable to the fact that they produce additional softening in the adjoining margins of the flap and stump, and delay their return to the conditions of healthy corneal tissue.

Choice of operation and after-treatment.—The hope has been expressed that with an increased knowledge on the subject of post-operative astigmatism, we might be able to choose or devise some special form of operation that would reduce it to a minimum, or prevent it entirely. But if the cause lies in the essential fact of an incision into the cornea that necessarily lessens its resistance, this hope will have to be abandoned, and all we can do in the choice of an operation will be to keep the incision sufficiently far away from the visual zone of the cornea, and to secure prompt and complete healing.

The cases upon which this paper was based were 32 of simple extraction, with the incision entirely in the clear cornea, 12 cases of extraction with iridectomy, with the incision in the sclero-corneal junction, and 4 cases of iridectomy for glaucoma, the incision in the periphery of the anterior chamber. A careful study of

them failed to show any advantage of one operation over another in the matter of astigmatism.

The thought will occur that if the bulging could be prevented by outside pressure, the astigmatism would be prevented. But, as I have already urged in a paper before the Amerian Medical Association in 1891, any such application of pressure is impracticable, and the attempt certain to be injurious.

Where prolapse or incarceration of the iris has occurred, the removal of the involved iris may hasten the condition of permanence, but will not diminish the ultimate amount of astigmatism sufficiently to justify a resort to it on that account.

The correction of post-operative Astigmatism.—Many of those who recognise its existence speak of it as unimportant, or to be corrected, not by a cylindrical lens, but by placing obliquely a spherical lens.

The need of the improvement of vision gained by the correction of 1 or 2 or 3D. of astigmatism, is as great for a patient who has undergone cataract extraction, or iridectomy, and so quickly acquired the astigmatism, as for a patient in whom the astigmatism is congenital, or of slow development.

The imperfect visual acuteness often present in the former class of patients is, I believe, more than balanced by the fact that astigmatism is new to them. Even if its correction will not give as good vision as may be obtained by the correction of some case of congenital astigmatism, the fact that the patient has been accustomed to seeing without astigmatism, will cause him to appreciate as highly the relief afforded. In any case of cataract extraction that can be properly classed as successful, it seems to me important to correct the astigmatism.

Now, as to the method of correction. Theoretically, it is true that by looking through a strong spherical lens, regular astigmatism may be corrected. But, as I

pointed out in the paper before the American Medical Association in 1887, on the effect of obliquity of correcting lenses, such a correction is far less satisfactory and far less beneficial than the correction by the ordinary cylindrical lens. The proper cylindrical effect is only obtained at a certain angle, and at an angle where the slightest deviation either way produces a perceptible change in the cylindrical effect, so that the patient who gets his cylindrical effect by looking obliquely through a spherical glass is constantly getting, instead of the proper amount, not enough, or a little too much.

On the other hand, with the cylindrical lens, and the visual axis perpendicular to the lens, there is a considerable angle on either side of the perpendicular, through which the change of cylindrical effect is imperceptible; and, on this account, if the lenses are properly mounted, it becomes difficult for the patient to get a cylindrical effect which will be seriously incorrect.

One other point. The reason urged for not employing a cylindrical surface upon the cataract glass is that it renders necessary the use of a more convex spherical surface, increasing the weight of the lens and the amount of spherical aberration. The increase of weight in a plano-spherical over a double convex that is absolutely necessary is so slight as to be of no practical importance. The increase that happens in the use of such lenses in practice depends on the inferior selection and grinding of the lens by the optician. The spherical and chromatic aberration of even a strong cataract glass, especially through the small pupil obtained by a simple extraction, are not the most serious defects in a strong lens. The effect of looking obliquely through lenses is of much greater practical importance. And, by placing the spherical entirely on one surface—if convex, the surface away from the eye—we secure an arc of the ideal periscopic lens, one which should have the centre of its refractive surface at the centre of rotation of the

eye-ball, and reduce to the minimum the effects of looking obliquely through the refracting surface.

Indeed, so important is this matter, that where the cylindrical lens was to be employed in connection with the strong spherical, I have used the concave cylindrical with the convex spherical, turning the former toward the eye; the latter from it, and have found such a lens as satisfactory, or more satisfactory, than those made with both spherical and cylindrical surfaces convex.

The teaching of the non-correction of astigmatism after cataract extraction seems to me utterly opposed to good sense. And practice based upon it is only excusable on the ground of an insurmountable constitutional indisposition to do thorough work.

HEESE (Halle). On the Influence of the Sympathetic Nerve on the Eye, especially on the Movement of the Iris. *Pflüger's Archives of Physiology, lii., p.* 535.[1]

In the first part of this paper, which covers a large series of delicate experiments, the author endeavours to clear up the question in what way the sympathetic nerve influences the movements of the iris. Three different theories have been advanced to account for the movements of the pupil.

(1) By accepting the existence of a sphincter muscle on the one hand, under the control of the third nerve, and of a dilator muscle on the other hand, under the control of the sympathetic.

(2) By a sphincter muscle alone, the dilatation taking place by the elasticity of the iris tissue. The influence of

[1] Compare with abstract of paper on "Mechanism of Movements of the Iris," OPHTHALMIC REVIEW, 1893, p. 50 [ED.].

the sympathetic is only an indirect one, by effecting contraction of the vessels of the iris, with consequent dilatation of the pupil (theory of Grünhagen).

(3) By a sphincter muscle alone, on which the sympathetic acts as an inhibitory nerve, producing dilatation by relaxing the sphincter (Gaskell).

The existence of a dilator muscle has been denied on the following grounds : (*a*) The difficulty of demonstrating such a muscle under the microscope, a difficulty increased by the pigmentation of the iris. (*b*) The movements of the iris cease after cutting the third nerve, while they go on after cutting the sympathetic, with only this difference, that in the latter case the pupil becomes narrower. On the other hand, stimulation of the sympathetic produces unmistakable mydriasis, a phenomenon so marked and invariable that it requires an explanation of its own.

The reasons which tell against Grünhagen's theory are various. Firstly, the investigations of Arlt and those of Frank show that the dilatation of the pupil and the contraction of the iris vessels, as produced by the stimulation of the sympathetic, occur independently of each other. They are neither synchronous (within reasonable limits), nor are they transmitted along the same nerve tracks. Jegorow has proved that stimulation of the long ciliary nerves alone produces dilatation of the pupil, while the bloodvessels are not affected thereby. In addition to this, the effect of a change in the size of the bloodvessels can be completely eliminated by emptying them, either by bleeding the animal to death, or by compressing or tying the innominate, the left carotid and vertebral arteries. In both cases Heese proved by convincing experiments that dilatation takes place promptly after stimulation of the sympathetic.

It was Brown-Séquard who first expressed the view that the sympathetic acts as an inhibitory nerve on the sphincter. According to him, irritation of that nerve produces contraction of the vessels of the iris ; this causes relaxation of the sphincter, hence dilatation of the pupil.

As the histological demonstration of a dilator muscle

under the microscope offers such great difficulties, attempts to prove its existence must be made by physiological experiment. In this direction Heese verified and enlarged in the first instance the experiments of Hurwitz, who showed that excised parts of the ciliary portion of the iris, in cats and rabbits at least, are contractile in a radiary direction. He then removed in rabbits the sphincter by excising all the central (pupillary) portion of the iris. The remaining ciliary portion was then lifted up from the lens in a conical shape, and with the help of Grünhagen's thermotonometer an electric current was sent through the whole ciliary portion of the iris. Contraction promptly followed, and was registered on a drum.

Contractility of the peripheral part of the iris having thus been demonstrated, it only remained to show that its contraction follows stimulation of the sympathetic. For this purpose Heese had to experiment on cats, the contraction of the ciliary portion of the iris in rabbits after the excision of the sphincter being too great to admit of easy observation.

The animals were either killed or curarised. In the latter case artificial respiration was established, and the sympathetic nerve was cut to avoid any possible reflex along that track. In the case of the killed animals, it was found that irritability was kept up about half an hour after death. In either case stimulation of the cervical end of the sympathetic produced an unmistakable radiary contraction of the iris. Proof has thereby been established physiologically of the existence—at least in some animals, such as the cat and dog—of a dilator muscle of the pupil which is innervated by the sympathetic. Difficult as it had been to prove this proposition beyond doubt, it was found still more difficult to register the contractions of this dilator muscle on a drum. By the orbital muscle the eye of the cat is pushed out when the sympathetic is stimulated; different means had therefore to be adopted to eliminate this source of mistake, *e.g.*, various modes of mechanical fixation of the eyeball. It was also found that by cutting the vidian nerve, contraction of the orbital muscle was

completely prevented. By cutting this nerve the communication between the internal carotid plexus and the spheno-palatine ganglion (*via* the large deep petrosal nerve) is severed.

These extremely difficult experiments, still more complicated because the eye had to be kept submerged under a 0.6 per cent. solution of sodium chloride, gave curves of a gentle rise and fall as the expression of a contraction of about fourteen to sixteen seconds duration, while the period of latent stimulation lasted about two seconds, quite in harmony with the ordinary behaviour of organic muscle fibres. Physiological experiment has therefore proved the existence of a special dilator muscle of the iris, at least in the cat.

Having arrived at this positive result, the author further attempted the histological demonstration of that muscle. He found it to consist, not of à continuous membrane, as asserted by Henle, Merkel, and others, but of separate bundles of a spoke-like arrangement situated immediately in front of the membrana Bruchii, therefore behind —not in the same plane as—the sphincter.

In the second part of his paper the author investigates the influence of the sympathetic nerve on the orbital muscle and blood-vessels in various animals, and in the third part he gives the results of his experiments on the influence of the sympathetic on the form of the cornea and lens. In opposition to the conclusions of Claude Bernard and of Brown-Séquard, he finds that the sympathetic has no influence on the curvature of the cornea. As for the lens, Morat and Doyon, in 1891, attributed to the sympathetic the *rôle* of an inhibitory nerve on the ciliary muscle, and thereby on the mechanism of accommodation. Heese found by his experiments that in no way is the curvature of the lens affected either by cutting or stimulating the sympathetic nerve, which would appear therefore to have nothing whatever to do with accommodation.

K. G.

L. MÜLLER (Vienna). Notes on Ophthalmic Operations. *Klin. Monatsbl. f. Aug., xxxi., p.* 350.

Since Berlin first reintroduced extirpation of the lacrymal sac with the knife instead of with chemicals or cautery, two methods of operating have been practised; in one the sac is opened with the first incision and then dissected out: in the other, the sac is not opened. Both these methods have been for years practised in Professor Fuchs' clinic, and it has been found that a thick-walled sac can be easily removed unopened, and that for such sacs this is the best operation; it is also desirable when removing a thin-walled lacrymal sac to keep it unopened, but this is almost impossible by the usual method, and when once incised the sac must be removed piecemeal—a very tedious proceeding and a very difficult one if there is much hæmorrhage. This will be the case no matter what care is taken to keep close to the sac, should the venous network round it not have become obliterated by previous inflammation.

The indications for the operation are given by Dr. Müller as follows:

(1) If the patient cannot for any reason be treated with Bowman's sounds.

(2) If the lacrymal duct is obliterated, *e.g.*, by lupus, &c.

(3) If the sac wall is so thickened that a return to its normal state is not to be hoped for.

(4) If tuberculosis of the sac is suspected.

(5) If caries of the bones complicates the dacryo-cystitis.

(6) In most cases if the dacryo-cystitis is present with abscess of the cornea or a ripe cataract.

(7) If the sac is very much enlarged and has thin walls.

When the sac-wall is thick the operation is performed as follows: an incision $1\frac{1}{2}$ cm. in length, with a slight concavity towards the inner canthus, from which its centre is distant about 3 mm., is made through the skin only, the palpebral ligament is divided on a director, and the sac is easily separated on its nasal side, and then carefully dissected out above, in which proceeding the separated palpebral ligament will be found a useful guide; it is next

grasped with forceps, the dissection on the outer side is completed and cut away from the lacrymal duct, the scissors being pushed down as far as possible in this proceeding ; the duct is scraped out with a sharp spoon as ar down as its nasal end, and the wound having been carefully sutured and a compress applied, the operation is complete ; any secretion will drain out through the nose. It is almost impossible to perform this operation if the sac is very thin-walled without rupturing it, owing to the difficulty of dissecting out the outer or temporal side, but Dr. Müller has found that if (the contents of the sac having been carefully expressed) a sharp pointed bistoury is driven in so that its point comes against the ridge of the lacrymal bone and the opening thus made prolonged upwards so as to divide the palpebral ligament, and downwards as far as is necessary, the usual difficulty will be avoided ; for after such an incision the sac will be exposed and can be easily felt with the finger, and dissected out with scissors. In twelve cases operated on by Dr. Müller in this way the time employed was only three minutes instead of the half hour usually required if the sac is ruptured, and, in addition, the wound was much less infected by septic material owing to the preliminary expression of the sac. Dr. Müller has found a speculum designed by himself of great use in keeping the lips of the wound apart ; a description of it may be found in Czermak's work on " Operations on the Eye."

W. G. Story.

JULES MUTERMILCH. Trachoma. *Annales d'Oculistique, January*, 1893, *p.* 41.

The author points out that there is very little agreement as to the meaning of the word "trachoma." For some, a single granulation establishes the diagnosis; for others, the granulations must be in the palpebral conjunctiva; and for others again it is only the cicatrices left by the granulations which are pathognomonic. As to etiology, the same disagreement appears: some consider trachoma a specific disease, caused by a special micro-organism, and having no connection with follicular conjunctivitis (Sæmisch); others believe that it is merely a later stage of this latter affection; a third group is to be found who consider all chronic conjunctivitis to be trachomatous in its nature. In all this chaos, however, there are some points of agreement, viz., the contagiousness of the malady and its infectious origin, the tendency which it has to become endemic, and lastly its prolonged course and frequent involvement of the cornea.

The author puts forward a theory which attempts to reconcile these facts with the varied experiences of clinical observers. He has examined with the microscope many cases of chronic conjunctivitis of all kinds, and has always found appearances resembling each other, the difference being merely one of degree. This agrees with clinical observation, which can only distinguish what is called true trachoma from other forms of conjunctivitis, such as follicular conjunctivitis, by the course of the disease and its result, and, indeed, Dr. Mutermilch has observed that a chronic irritation such as is produced by the daily use of atropine or eserin, may result in granulations (*i.e.*, hypertrophy of the sub-epithelial adenoid tissue), which, however, pass rapidly away when their exciting cause is removed. Many oculists also who have had opportunities of observing epidemics of this disease have noted the development of true trachoma from follicular

conjunctivitis,[1] and have professed themselves unable to distinguish between the two.

Bacteriological research has thrown no light on the question, even the coccus of Michel, the most popular one, having fallen into disrepute.[2] Many observers, however, have noted the interesting fact that the state of health and hygienic surroundings of the patient have much to do with the contagiousness and severity of the disease, whose very course, characterised as it is by so frequent and such sudden exacerbations, alternating with long periods of quiescence, is almost conclusive against its parasitic origin, but may easily be explained by supposing that the epithelium has undergone some change which renders it peculiarly non-resistant to noxious influences.

The theory advanced by the author is as follows :—The normal conjunctiva is, as we know, a mucous epithelium lying on a layer of loose adenoid tissue. All through the organism there is a fixed relation between the nature of the epithelial membrane and the tissue on which it lies. Under a mucous or cylindrical epithelium will always be found adenoid tissue, and under epidermoid epithelium compact connective tissue. This is easily intelligible when we consider the function of a mucous epithelium, and how, in fact, its powers of resistance to noxious agents depend on the rapidity with which it can renew itself; thus, if we examine a conjunctiva which is kept inflamed by any chronic irritation such as smoke, irritating vapours, dust, or micro-organisms, the epithelial layer will be found to have become thicker from the great activity with which the cells in the deeper layers reproduce themselves. If, however, we examine a case of old trachoma (*i.e.*, in the cicatricial stage), we find the sub-epithelial tissue is a dense connective tissue, the epithelial layer itself epidermoid in character. The epithelium in this case resists irritants,

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[1] Nuel et Leplat, *Annal d'Oculistique*, 1889, Mars, Avril. Wallerstein, *Berlin Klin. Wochens.*, 1888, No. 20. Gerken, *Annal d'Oculistique*, T. cviii., p. 152. Joelson, *Wiestnik. Ophtalm.*, 1889, Juillet, Octobre. Schilling, *Berlin Klin. Wochenschrift*, 1888, No. 22.

[2] Schmidt-Rimpler, X., *Congrès Int. d. Med.*

not by rapid reproduction, but by the dense nature of its external layers. This change is brought about by the constant attacks of inflammation which occur in the course of the disease, each one causing a small-celled infiltration of the sub-conjunctival tissues. The infiltration may at first be totally absorbed on the disappearance of the inflammation, but, if this is too severe or of too long standing, the change into connective tissue occurs. If the normal adenoid tissue has been largely replaced by this connective tissue, the epithelial cells in the deeper layers are found to have become oval, fusiform, or triangular in shape, and those in the more superficial layers, flattened, in many cases with a nucleus which it is almost impossible to demonstrate. The phase in which the epithelium, having lost its power of rapid reproduction, has not yet acquired the power of protecting itself by a horny layer, is the second phase of the disease, and it is then that eyes are said to be affected by true granular ophthalmia or trachoma, a condition in which the severe complications and course are to be expected from the non-resisting state of the epithelium. In time, however, the epithelium, becoming more epidermoid in character, again acquires powers of resistance, and the trachoma is cured.

It remains to consider the epidemic nature of the disease and its supposed contagiousness.

In this Dr. Mutermilch does not, of course, believe, and he cites in support of his views the fact that neither nurses nor doctors get infected by their patients, and states that a healthy man whose eyes are inoculated with trachomatous secretion will be attacked only by a mild transient form of conjunctivitis; as this secretion is known to be charged with micro-organisms (staphylococcus aureus, albus, strepto-coccus, &c.), the outbreak of conjunctivitis is not surprising. Any other septic secretion will have the same effect. It is true, however, that an inflammation of this kind may, under suitable conditions (overcrowding, unsanitary surroundings, &c.), develop into so-called true trachoma, and in this way may be explained the occurrence of epidemics. As pathological processes

in similar tissues, wherever situated, resemble each other closely, it is to be expected that in the urethra, for instance, analogous results will be found, and, in fact, Baraban[1] has noted in chronic blennorrhœa of the urethra the conversion of the cylindrical into a flat stratified epithelium, and Singer,[2] in noting the same conversion, affirms that it is due to the alterations in the sub-epithelial tissues. W. G. Story.

Reche (Breslau). What Part of the Iris ought to be selected for an Optical Iridectomy? *Archives of Ophthalmology* (*German edition*), *xxvii.*, 3 *and* 4, *p.* 147.

It seems to be a prevailing idea that an iridectomy for optical purposes ought to be made in the inner (nasal) quadrant whenever there are no special reasons for selecting another part, and that the temporal quadrant should be avoided. At the first glance this may appear very plausible, inasmuch as the eye requires an inward position for binocular fixation of near objects; an inward (nasal) iris coloboma might therefore be expected to facilitate binocular vision.

Reche now points out the fallacy of such a *prima facie* inference. If rays of light fall on a lens, it makes very little difference what part or parts of the lens are utilised for the production of the image. Experiment will easily verify this. If an image, say of a candle, is formed on a screen by the help of a convex lens, the greater part of this lens may be covered so as to allow only a small opening for the light to pass through, yet it will be found that wherever the aper-

[1] *Rev. med. de l'Est.*, 15 Juin, 1890.
[2] *Arch. f. Derm. und. Syph.*, 1891.

ture may be, the image will not be affected in size or locality, the only noticeable difference being in its brightness. (This fact, we may observe, is often utilised by astronomers. The big objective lenses of large refractors not unfrequently contain flaws — air bubbles, &c. — which would cause dispersion of light and impair the sharpness of the image. In many such cases the lens is covered by a patch of dark paper, or even sticking plaster ; occasionally more than half the surface of the lens is thus blocked out, improving the image, in spite of the reduced brightness.) This holds good for the greater part of a lens. In the peripheral portion, however, spherical aberration takes place, that is to say, rays passing through the periphery of a convex lens are more strongly refracted than those passing through the centre. If, therefore, a small aperture be made near the periphery of the iris in the inner quadrant the image will be formed on the temporal side of the macula, and in order to cause it to fall on the macula the eye will have to be turned inwards. Consequently, to obtain binocular vision a greater amount of convergence will be required with an artificial pupil on the nasal side than with an artificial pupil on the temporal side, and the fatigue and distress that result from excessive convergence will be more likely to arise when the pupil is in the former situation than when in the latter. For these reasons—and also because a temporal coloboma gives a wider field for indirect vision—Reche advocates a temporal iridectomy as the most suitable, unless special circumstances demand it elsewhere, the upper and the lower quadrant of the iris being even more unsuitable than the inner quadrant.

Dr. Reche's reasoning appears quite correct, but one point seems to have been overlooked, which is evidently of importance., viz., the fact that the corneal curvature is by no means spherical. We know that the peripheral parts of the cornea are less curved—have a longer radius—than the central. We know, furthermore, from ophthalmometric observations that the radius of the curvature is greater towards the nasal than towards the temporal part of the cornea. This would affect the spherical aberration con-

siderably, and in the sense of neutralising it more in the nasal than in the temporal quadrant. How far this is the case it would be difficult to say without careful investigation; but Dr. Reche's conclusions must be accepted with reserve until this point has been elucidated.

K. G.

SIDNEY STEPHENSON (London). Ophthalmic Nursing. *The Scientific Press, Limited, London*, 1894.

This small book of 180 pages, inclusive of three appendices, contains a large amount of information; more, we think, than the average nurse will desire, or is likely to possess. The author has evidently endeavoured to write in language which will be intelligible to nurses of all grades, and although we may differ as to some of his statements, we congratulate him on the clearness with which they are expressed.

The first chapter on "The Human Eye; its Structure and Action" appears to us the least satisfactory in the book. In the frontispiece—a "Vertical Section of the Eyeball and Eyelids"—the artist has apparently endeavoured to combine a vertical section of the orbit and a horizontal section of the eyeball, making it appear that the antero-posterior axis of the globe cuts the retina some distance above the level of the optic disc. No explanation is given of the apparent anomaly. On p. 13, the reference to fig. 2 is incorrect, and we find the statement that the layer of rods and cones of the retina "is more or less embedded in the choroid." Further on it is said that, "the rods and cones are the only part of the retina acted upon by light." No mention is made anywhere of the hexagonal pigment layer. There are other somewhat similar inaccuracies, and the whole chapter is much less careful than those which follow. Chapters II. and III., upon "The Germ Theory of Disease" and "Contagion and Infection,"

are good, and the latter contains useful rules for the avoidance, by nurses and others, of the contagion of eye disease. In Chapter IV., on "Remedies," the writer does not, we think, sufficiently emphasise the danger of applying lead lotion indiscriminately in cases of eye disease. Nurses are not wholly guiltless of "lead deposits" upon the cornea, and it would not be unwise to counsel them never to apply lead lotion without the sanction of a medical man. Chapters V. and VI. are upon "The Application of Remedies to the Eyes" and "Anæsthetics, local and general." In the latter we notice that the author advises a 4 per cent. solution of cocaine for ordinary use. In our own experience a 2 per cent. solution is sufficiently strong for non-inflamed eyes. Chapter VII. gives a very brief account of "The Commoner Operations upon the Eyes." Chapters VIII., IX., X., concerning the "Arrangements for Operations," "Dressings and Bandages," and "Nursing of the Different Operations" are very good and practical, and nurses (and house-surgeons in charge of eye cases) may gain much useful knowledge therefrom. Chapter XI. gives "A Brief Account of the Commoner Diseases of the Eyes, with Hints as to their Nursing." Chapter XII. deals with "Shades, Artificial Eyes, and Spectacles." In Chapter XIII. are instructions for the epilation of eyelashes, removal of foreign bodies, the examination of troublesome children, and the taking of temperatures. Chapter XIV., on "Dark Rooms and Disinfection" is short and to the point.

At the end of the book we find, in Appendix I., instruments needed for the principal operations, and in Appendix II. illustrations of these instruments. These appendices will be of service if the nurse is responsible for the instruments. Appendix III. is a glossary, eleven pages long, of a curious collection of medical and non-medical terms. We doubt if nurses require to be informed that a "camera" is "an instrument used to take photographs," or that they will add to their stock of useful knowledge when they read that "opacity" means "dimness," and "stimulus" a "stimulant"! Several of the author's ex-

planations do not commend themselves to us, *e.g.*, the word *punctum*, unless qualified, cannot be held to signify the opening of the lacrymal canaliculus; *presbyopia* is not wholly, even if partly, due to weakness of the ciliary muscle; the description of the suspensory ligament of the lens is mystifying even to the initiated. In brief, the glossary, though containing much that will help a nurse in reading the book, requires careful revision. The book is nicely printed, and singularly free from typographical errors.

R. L. RANDOLPH (Baltimore). A Clinical Study of the Eye Symptoms of Cerebro-spinal Meningitis. *Bulletin of the Johns Hopkins Hospital, vol. iv., No.* 32.

Most writers lay stress upon the frequency and importance of eye symptoms in connection with this disease; and, probably in every case, careful examination would show the involvement of the eye at some stage in some one or more of its parts. Swelling of the lids, conjunctivitis and photophobia are frequent. The pupils may be dilated or contracted: or, one dilated and one contracted. Pus has been observed in the anterior chamber, and the presence of parenchymatous keratitis has also been recorded. Hyperplastic choroiditis with succeeding retinal detachment and iritis occurred in ten cases in an epidemic observed by Knapp. Simple irido-choroiditis and purulent inflammation of the uveal tract and pan-ophthalmitis have frequently been noted.

Randolph examined thirty-five cases ophthalmoscopically; most of them several times during the course of the disease. He found the fundus normal in only seven instances; and three of these were seen early in the disease and would probably have exhibited pathological

conditions, had they been examined shortly before death. He found optic neuritis six times and retinitis once. In nineteen cases, there was great engorgement and tortuosity of the retinal veins, and more or less congestion of the optic disc. It is more than likely that had the patients survived, neuritis would have been followed by optic atrophy; and, it is possible that the numerous instances of congestion of the optic disc were simply beginning stages of optic neuritis.

Of the seven cases which exhibited no fundus lesion at the time of ophthalmoscopic examination, one had divergent strabismus and dilated pupils, another had marked nystagmus, and still another had greatly dilated pupils.

The most interesting case was one of thrombosis of the central retinal vein and hæmorrhagic retinitis. When first seen, only six days after the onset of the illness, the eyes were normal. Three weeks later, in the right eye, the upper half of the papilla was nearly covered by an extravasation that resembled a blood clot and seemed to fill the entire optic nerve cup. The colour was a deep blackish red. The large arteries were almost empty, simply showing a faint column of blood. The veins were enormously distended, tortuous, and very dark. There were several hæmorrhages around the papilla, but not in other parts of the fundus. Their dark colour was very striking. The part of the papilla not covered by the clot was pale and smoky. The retina was cloudy throughout, without special changes at the macula.

In the left eye, the arteries of the retina were possibly narrowed; the veins tortuous and engorged, and numerous hæmorrhages were seen around the optic nerve entrance.

The child died eight hours after examination.

There was strabismus in eight cases, all divergent; and in every instance it was the right eye which diverged. On four occasions the right pupil was dilated, the left unchanged. In three cases of neuritis the lesion was more marked in the right eye, and in the case of thrombosis, it was the right that was most affected. Randolph points out that this peculiar tendency to lesions on the right side has been observed by others, but can offer no satisfactory reason for it.

The patients ranged from 13 months to 35 years, the average age being 9 years.

The three cases examined in which the eyes were entirely unaffected were all females. Two of them recovered; the third probably presented eye symptoms later in the disease.

In cases not of this epidemic, Randolph has seen atrophy following optic neuritis and in one where the child remained, to all appearances, totally blind during a long illness, and where bad vision persisted some time after recovery, it was stated a year later that he could see as well as ever. Generally, however, the treatment of such cases of atrophy is unproductive of good.

It would seem that all epidemics of cerebro-spinal meningitis have one or more eye symptoms in common, and probably those most often met with are conjunctivitis and the changes in the pupils. But every extensive epidemic is apt to be associated with a special type of eye affection, the type in this particular one being venous engorgement of the retina and optic neuritis.

In all epidemics of cerebro-spinal meningitis, a systematic examination of the eye should be made with the ophthalmoscope, and frequently when other symptoms are absent and the general symptoms are misleading, changes in the fundus of the eye will be discovered which will throw light upon the case. The existence of good vision does not necessarily mean a sound optic nerve or retina. Of the thirty-six cases examined, only three complained of inability to see distinctly.

The existence of eye changes, especially in the fundus, is regarded as indicating a particularly grave condition. Where these were very pronounced, Randolph felt justified in speaking positively as regards prognosis. This type of eye symptoms seems to have more value as indicating the condition of the brain, than such affections as pan-ophthalmitis or keratitis, which would be likely to have their origin in a general infection and not result directly from cerebral changes.

E. J.

E. FUCHS (Vienna). Retinitis Circinata. *Von Graefe's Archiv, vol. xxxix., Part* 3, *p.* 227.

The name retinitis circinata is given by the author to a group of cases which he has carefully studied and followed over a period of years, and which he has not found accurately described elsewhere. The characters of the disease are briefly summarised as follows:—

Retinitis circinata reveals itself to the ophthalmoscope as a grey or greyish yellow opacity in the macula and its neighbourhood, surrounded at a certain distance by a belt of small white spots or larger white areas. Vision is much impaired by the presence of a central scotoma. The disease runs a chronic course, extending over many years. The changes in the fundus may disappear, or lead to permanent thickening of the retina; in either case vision remains permanently impaired.

The disease is rare. Among 70,000 patients seen during seven and a-half years in the Vienna clinic, Fuchs observed eleven cases; one case he had noted previously. Ten of the twelve patients were women, the youngest being 38 years of age, the eldest 75; the average age was 60. In seven of these patients the disease affected one eye only, in five it affected both. In all cases it was the failure of vision which caused the patient to seek advice; pain was never present.

The retinal changes are of two kinds—the patch at the macula, and the spots which are arranged in a belt around it. The macular patch in the early stage is small and sharply defined; later, it involves an area equal to, or larger than, that of the papilla, and is usually without sharp limit. The retina here is more or less clouded, and of grey or yellow colour. The minute vessels which approach the macula traverse the clouded area without being hidden; the opacity therefore lies behind the vessels. In severe cases the affected area of the retina is demonstrably thickened. Small hæmorrhages, and in the later stages pigment spots, are sometimes visible in the macular patch. The belt or girdle of spots is separated from the macular

patch by a comparatively healthy zone. It is generally incomplete, being divided into an upper and a lower portion by gaps at the nasal and temporal sides. Its relation to the papilla varies. As a rule the papilla lies somewhat beyond the area included by the belt, but is occasionally involved in it. The belt, even when complete, is not quite circular, but has the form of an ellipse, with its long axis horizontal. It is made up of a multitude of milk-white spots, which stand out sharply from the red background, and have no pigmented margin. These spots, when isolated, are hardly so large in diameter as the chief retinal vessels, but they are often confluent, and arranged in graceful foliate forms, and these, on further combination, form large white patches. The retinal vessels always pass unhidden over these white patches.

In advanced cases vitreous opacities were sometimes seen, and in two instances detachment of the retina occurred.

No histological examination of the retina has yet been made, but certain inferences concerning the nature of the changes are justifiable. The white patches which occur in albuminuric retinitis depend largely on sclerosis of the nerve fibres. Those which occur in circinate retinitis cannot be due to this cause, for they lie entirely behind the retinal vessels. They cannot be due to aggregations of white corpuscles, as in some acute inflammatory conditions of the retina, for there are here no signs of acute inflammation. It appears more likely that they are due to an exudation of albuminous fluid into the tissue of the retina. Iwanoff has described an œdema of the retina in which vacuoles are formed in the granular layers, which, when they extend, become confluent and present an appearance, when viewed from the surface, much resembling the foliate grouping of the dots in retinitis circinata. The arrangement of the patches appears to bear no definite relation to the course of the retinal vessels, but corresponds rather with the course taken by the retinal fibres which arch round above and below the macula from the upper and lower margins of the disc.

The etiology of the disease remains doubtful. A careful investigation failed to show that it had any definite connection with syphilis, with changes in the urine, or with arterial sclerosis. The only definite points are that it occurs chiefly in women and in the later years of life.

In diabetic and albuminuric retinitis, and in some circulatory disturbances in the retina, white patches somewhat resembling those above described are sometimes to be seen, but they never present the complete and typical girdle-like figure which characterises retinitis circinata. The central guttate choroiditis described by Tay, Nettleship and others, can hardly be confounded with the condition in question, for the spots are yellowish rather than white, often ill-defined, and sometimes surrrounded with pigment; they are aggregated most closely in the region of the macula, which in retinitis circinata is free from white spots; moreover the choroidal disease is almost always binocular and causes comparatively little disturbance of vision. Finally, the retinitis punctata albescens of Mooren, which presents a multitude of white spots, scattered usually over the whole of the fundus, and which occurs in young persons and usually in several members of one family, is to be distinguished from the condition now described by Fuchs. P. S.

ALFRED BECKER (Heidelberg). A Contribution to the Knowledge of Glioma of the Retina. *Von Graefe's Archiv, xxxix.*, 3, p. 280.

Glioma of the retina has been the subject of a large number of investigations, but we are yet unable to come to a definite conclusion as to its essential nature and origin, and it is only by the accumulation of exact observations, and the recording of peculiar deviations from the common type that we can hope to reach finality in our

knowledge. Becker describes three cases which have come under his notice which offer some peculiarities, and from which he draws conclusions which support the views of Da Gama Pinto as to the essential nature of glioma retinæ. The first case was that of a child ten weeks old, in whom a squint followed by a bright reflex from the back of the eye had been noticed only a few days before. The globe was enucleated ; there was no recurrence of the growth in the orbit, but the other eye was found to be occupied by a similar tumour. The second case was that of a child 16 months old, in which there was a glioma of one eye noticed immediately after birth, but in the other eye a diffuse cloudiness of the vitreous, which prevented the fundus from being explored satisfactorily. There was some vision left as the child followed the light and grasped at surrounding objects. This cloudiness of the vitreous depended on a slow inflammatory process, and the possibility of the whole affection in both eyes being tubercular was considered, but had to be rejected as the affection in one eye was present at birth, and a congenital ocular tuberculosis has never been proved to exist. The most probable explanation was that the glioma of the left eye was complicated by a slow cyclitis of the right eye, and that this might be caused by a glioma in its early stage. The progress of the case showed the latter explanation to be the true one, as an undoubted glioma was observed later. In the third case, a boy aged 3, attention was first called to the eye by a considerable spontaneous hæmorrhage into the anterior chamber, which for a long time obscured the true nature of the affection. This is noteworthy, as it is possible that hæmorrhage, occurring as the result of a very slight injury, may be due to a new growth in the eye. The large calibre and thin walls of the vessels of a gliomatous neoplasm favour the occurrence of hæmorrhage.

If we briefly recapitulate the structure of these three cases of glioma, we find in all of them a marked lobular or alveolar arrangement. Broad layers of cells are arranged in concentric rows around the vessels, and each

lobe thus formed is separated from other lobes by areas of necrosed cells. In addition, in one of the cases the lobes themselves were found to be made up of secondary lobules, consisting of a central space surrounded by a circle of long cylindrical cells. Even after careful examination of the lumina of the secondary lobules, it was not possible to make out endothelial cells or other remains of vascular walls; they contained masses of changed blood cells, so that they ought probably to be regarded as simple blood spaces without walls. The general form of these growths bore a definite relation to the distribution of bloodvessels within their substance, and they should be considered as angeiosarcomata, sometimes having a tubular form, and being part of the larger class of sarcomata of the nerve connective tissue. If it be objected that neuroglia has an epiblastic origin, and that a sarcoma which belongs to the connective tissue type cannot take origin from an epiblastic tissue, the answer should be that no one has ever seen a glioma arise from the neuroglia itself, and that mesoblastic cells are sufficiently present in the retinal bloodvessels to give rise to sarcoma. Mesoblastic cells which have wandered into the retina from elsewhere, as cells from the vitreous passing by means of communications between a persisting hyaloid artery of the vitreous and branches of the retinal artery, may give rise to gliomatous growths. As to the vascular changes, in one of the cases there were thickenings of the whole vessel wall with obliteration in places; the cells adjacent to the obliterated vessels were less intensely coloured, and were necrosed. In another case the hyaline degeneration was more marked in the form of broad bands which were coloured an intense red by the Ernst hyaline reaction, showing them to be essentially a degeneration of connective tissue.

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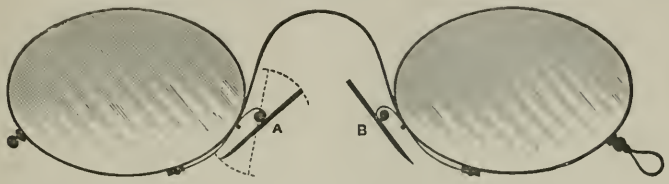

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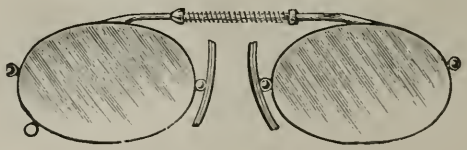

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